

**GROUND TERMINAL AND METHOD FOR MOUNTING A PRINTED BOARD
MOUNTED WITH A GROUND TERMINAL TO A CHASSIS**

CROSS-REFERENCE TO A RELATED APPLICATION

5 This nonprovisional application claims priority under
35 U.S.C. § 119(a) on Patent Application No. 2003-114555
filed in Japan on April 18, 2003, the entire contents of
which are hereby incorporated by reference.

10 **BACKGROUND OF THE INVENTION**

Field of the Invention

The present invention relates to a ground terminal and
a method for mounting a printed board mounted with a ground
terminal to a chassis.

15 Description of the Related Art

In electronic equipment, especially in a vehicle-
mounted audio equipment, it is essentially required to take
a measure to reduce noise. To this end, a ground terminal
20 is mounted on a printed board and electrically connected to
a chassis, so that the printed board is grounded to the
chassis. Such a ground terminal is disclosed for example
in Japanese patent publication no. 2863981. As shown in
Fig. 11, this ground terminal 1 comprises a first
25 longitudinal half and a second longitudinal half which is
wider in width than the first half. The first half has
side edge portions each formed with a plurality of
connection portions 1a, and the second half is formed with
a mounting hole (screw insertion hole) 1c. The ground
30 terminal 1 is placed on a printed board, with the
connection portions (solder portions) 1a and the mounting
hole 1c individually aligned with connection portions and
a mounting hole formed in the printed board, and is then

mounted on the printed board by soldering the connection portions 1a to the connection portions of the printed board. The printed board is fastened to a chassis together with the ground terminal 1 mounted thereon by using a mounting
5 screw inserted to the mounting hole 1c of the ground terminal 1 and the mounting hole of the printed board and threadedly engaged with a tapped hole of the chassis, whereby the printed board is grounded to the chassis through the ground terminal whose annular portion around
10 the mounting hole 1c is electrically connected to the chassis through the mounting screw.

With miniaturization and high performance of equipment, the printed board is becoming increasingly smaller in size and increasingly higher in part mounting density. For this
15 reason, the ground terminal is demanded to be smaller in size and excellent in electrical connectability with the chassis.

However, the above-mentioned prior art ground terminal which is complicated in shape and difficult to be downsized
20 is not suitable for use in a small-sized equipment. Further, this ground terminal electrically connected to the chassis only through the mounting screw poses a problem that a large connection resistance is caused.

25 SUMMARY OF THE INVENTION

An object of the present invention is to provide a ground terminal which can be downsized and has good electrical connectability with a chassis, and provide a method for mounting a printed board, mounted with such a
30 ground terminal, to a chassis.

According to one aspect of this invention, there is provided a ground terminal which comprises a ground terminal body formed into an annular shape as viewed in

plan, and at least one connection portion formed integrally with the ground terminal body. The connection portion is bendable and extends from an inner circumference of the ground terminal body toward a center of the ground terminal.

5 The ground terminal of this invention having the annular ground terminal body and the connection portion that are formed into one piece is simple in construction, and can be downsized. On an occasion that a printed board mounted with this ground terminal is mounted to a chassis
10 by using, for example, a mounting screw inserted through a mounting hole of the printed board and threadedly engaged with a tapped hole of the chassis, when the mounting screw is caused to be inserted through the annular ground terminal body, the connection portion of the ground
15 terminal is bent in the mounting hole of the printed board toward the chassis, and a tip end of the connection portion is brought in direct contact with the chassis. The ground terminal is electrically connected not only through the mounting screw but also through the connection portion that
20 is in direct contact with the chassis, whereby the connection resistance between the ground terminal and the chassis decreases.

In this invention, the shape of the ground terminal body is not limited. The ground terminal may be formed
25 into a circular annular shape or a polygonal annular shape.

The length of the connection portion of the ground terminal measured from the inner circumference of the ground terminal body to a tip end of the connection portion is preferably larger than a thickness of that portion of a
30 printed board in which a mounting hole used to mount the ground terminal on the printed board is formed. In this case, the tip end of the connection portion bent in the mounting hole of the printed board toward a chassis is

brought in contact with the chassis with reliability.

The ground terminal is preferably provided with a plurality of connection portions that are formed integrally with the ground terminal body and spaced from one another in a direction of the inner circumference of the ground terminal body. These connection portions are bendable and extend from the inner circumference of the ground terminal body toward the center of the ground terminal. With this preferred embodiment, the connection portions are bent in the mounting hole of the printed board toward the chassis when the mounting screw is caused to be inserted through the ground terminal body when the printed board mounted with the ground terminal is mounted to the chassis using the mounting screw, and as a result, tip ends of the connection portions are brought in direct contact with the chassis, whereby improved electrical connection is established between the ground terminal and the chassis.

Preferably, the plurality of connection portions of the ground terminal are symmetric with respect to the center of the ground terminal as viewed in plan. In this case, the connection portions are bent uniformly when the mounting screw is caused to be inserted through the ground terminal body, whereby the tip ends of the connection portions are brought in contact with the chassis with reliability.

The ground terminal body may be used to establish electrical connection with a printed board to which the ground terminal is mounted. For instance, the ground terminal body is soldered to a solder portion formed as a connection portion in the printed board. In this case, it is unnecessary to additionally provide the ground terminal with a connection portion such as a solder portion used to establish electrical connection with the printed board,

making it possible to simplify the construction of the ground terminal and to downsize the ground terminal.

According to another aspect of this invention, there is provided a method for mounting a printed board mounted with a ground terminal to a chassis, which comprises the steps of: (a) preparing a ground terminal comprising a ground terminal body formed into an annular shape as viewed in plan, and at least one connection portion formed integrally with the ground terminal body, the connection portion being bendable and extending from an inner circumference of the ground terminal body toward a center of the ground terminal; (b) mounting the ground terminal on the printed board with the ground terminal body aligned with a mounting hole of the printed board; and (c) placing the printed board mounted with the ground terminal on the chassis, with the mounting hole of the printed board aligned with a tapped hole of the chassis, and tightening a mounting screw inserted to the ground terminal body and the mounting hole of the printed board and threadedly engaged with the tapped hole of the chassis, thereby mounting the printed board to the chassis and causing the connection portion of the ground terminal to be bent in the mounting hole of the printed board and to be brought in direct contact with the chassis.

According to the mounting method of this invention, the connection portion of the ground terminal is bent in the printed board and is brought in direct contact with the chassis when the mounting screw is tightened in mounting the printed board mounted with the ground terminal onto the chassis, and thus electrical connectability between the ground terminal and the chassis is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given herein below and the accompanying drawings which are given by way of
5 illustration only, and thus, are not limitative of the present invention, and wherein:

Fig. 1 is a perspective view showing a ground terminal according to a first embodiment of this invention, together with a printed board on which the ground terminal is to be
10 mounted;

Fig. 2 is a plan view of the ground terminal shown in Fig. 1;

Fig. 3 is a perspective view showing the printed board mounted with the ground terminal shown in Fig. 1, together
15 with a chassis to which the printed board is to be mounted;

Fig. 4A is a section view showing the printed board shown in Fig. 3 in a state where a mounting screw is inserted into an annular ground terminal body of the ground terminal and a mounting hole of the printed board;

20 Fig. 4B is a section view showing the printed board mounted to the chassis by tightening the mounting screw;

Fig. 5 is a plan view showing a ground terminal according to a second embodiment of this invention;

25 Fig. 6 is a plan view of a ground terminal according to a third embodiment of this invention;

Fig. 7 is a plan view of a ground terminal according to a fourth embodiment of this invention;

Fig. 8 is a plan view of a ground terminal according to a fifth embodiment of this invention;

30 Fig. 9 is a plan view of a ground terminal according to a sixth embodiment of this invention;

Fig. 10 is a plan view of a ground terminal according to a seventh embodiment of this invention; and

Fig. 11 is a plan view showing a conventional ground terminal.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 In the following, a ground terminal according to a first embodiment and a method for mounting a printed board mounted with the ground terminal to a chassis will be explained.

Referring to Fig. 2, the ground terminal 5 of this
10 embodiment, which is fabricated for example by stamping a metal sheet, comprises a ground terminal body 5' having terminal body portions 5b-5i and formed into an annular shape as viewed in plan, and a plurality of, for example, four connection portions (hereinafter referred to as first
15 through fourth connection portions) 5j that are tongue pieces formed integrally with the ground terminal body 5'. A cross recess 5a is defined between the ground terminal body 5' and the first through fourth connection portions 5j. The ground terminal body may be formed into a circular
20 annular shape or a polygonal annular shape as viewed in plan. The ground terminal body 5' of this embodiment is formed into an octagonal annular shape having an octagonal outer circumference and an octagonal inner circumference, and is comprised of first through eighth terminal body
25 portions 5b-5i.

The first through fourth connection portions 5j of the ground terminal 5 are provided so as to be spaced from each other along the inner circumference of the octagonal annular shaped ground terminal body 5', and are disposed to
30 be symmetric with respect to the center of the ground terminal 5 as viewed in plan. The first through fourth connection portions 5j extend from the inner circumference of the first, third, fifth and seventh terminal body

portions 5b, 5d, 5f, 5h toward the center of the ground terminal 5, respectively. The connection portions 5j have their triangular tip ends facing one another with a slight spacing. The length of each connection portion 5j measured from the inner circumference of the ground terminal body 5' to the tip end of the connection portion 5j is larger than the thickness of that portion of a printed board 2 in which a mounting hole 2a is formed. The connection portions 5j are bendable at the inner circumference of the terminal body portions 5b, 5d, 5f and 5h.

As shown in Figs. 1 and 3, the ground terminal 5 is mounted to the printed board 2 and is then mounted to a chassis 6 together with the printed board 2 by using a mounting screw 7.

As shown in Fig. 1, the printed board 2 is formed at for example its corner portion with a mounting hole 2a around which a connection portion 3 is formed. The connection portions 5j of the ground terminal 5 are connected to the connection portion 3 of the printed board. The connection portion 3 includes a plurality of solder portions, for example, first through fourth solder portions 3a-3d, which are disposed around and coaxially with the mounting hole 2a so as to be spaced from one another with a spacing g. The terminal body portions 5c, 5e, 5g and 5i of the ground terminal 5 are soldered to the solder portions 3a-3d of the printed board 2, respectively.

Referring to Fig. 3, reference numeral 6 denotes a chassis having a printed-board mounting portion 6a to which the printed board 2 mounted with the ground terminal 5 is mounted. The chassis 6 is made of an electrically conductive metal member. The printed-board mounting portion 6a of the chassis 6 is formed with a tapped hole 6b with which a mounting screw 7 is threadedly engaged. The

mounting screw 7 may be of a washer built-in type having a spring washer 8 and a plain washer 9.

In the following, a method for mounting the printed board 2 mounted with the ground terminal 5 to the chassis 6 will be explained.

First, the ground terminal 5, the printed board 2, and the chassis 6 having the aforementioned construction are prepared. Next, the printed board 2 is positioned at a predetermined position with respect to a mounter, not shown. Then, the ground terminal 5 is picked up by suction at its central portion, i.e., tip end portions of the first through fourth connection portions 5j of the ground terminal 5, by means of a suction nozzle of the mounter. Since the ground terminal is light in weight and the spacing between the tip ends of the connection portions 5j is narrow, the ground terminal 5 can be reliably held by means of the suction nozzle.

Next, the ground terminal 5 is placed on the printed board 2 by using the mounter so that the center of the ground terminal 5 is in alignment with the center of the mounting hold 2a of the printed board 2 and the terminal body portions 5c, 5e, 5g and 5i of the ground terminal 5 are in alignment with the solder portions 3a-3d of the printed board 2, respectively. Subsequently, the terminal body portions 5c, 5e, 5g and 5i of the ground terminal 5 are soldered to the solder portions 3a-3d of the printed board 2.

The surface tension of molten solder uniformly acts on the terminal body portions 5c, 5e, 5g and 5i of the ground terminal 5, whereby the ground terminal 5 is automatically positioned with accuracy around the mounting hole 2a of the printed board 2 since the terminal body portions 5b-5j are coaxial with the center of the ground terminal 5, the

solder portions 3a-3d are coaxial with the mounting hole 2a of the printed board 2, the four terminal body portions 5c, 5e, 5g and 5i of the ground terminal 5 are individually aligned with the solder portions 3a-3d of the printed board 2, and the solder portions 3a-3d are spaced with a spacing g. Thus, the ground terminal 5 is accurately surface mounted on the printed board 2 around the mounting hole 2a.

Next, the printed board 2 mounted with the ground terminal 5 is attached to the chassis 6. To this end, the printed board is first placed on the chassis 6, with the mounting hole 2a of the printed board 2 aligned with the tapped hole 6a of the chassis 6. As a result, the mounting hole 2a of the printed board 2, the terminal body 5' of the ground terminal 5, and the tapped hole 6a of the chassis 6 are in alignment with one another.

Subsequently, when the mounting screw 7 is caused to be inserted from above into the octagonal annular shaped ground terminal body 5', the first through fourth connection portions 5j of the ground terminal 5 are bent along the inner circumference of the ground terminal body 5'. When the mounting screw 7 is further inserted, the connection portions 5j are caused to be pressed into the mounting hole 2a of the printed board 2, as shown in Fig. 4A. The mounting screw 7 inserted into the annular ground terminal body 5' and the mounting hole 2a of the printed board 2 is brought in threaded engagement with the tapped hole 6a of the chassis 6. At this time, the connection portions 5j of the ground terminal 5 are bent substantially at right angles within the mounting hole 2a of the printed board 2, and tip ends of the connection portions are brought in direct contact with the chassis 6. Meanwhile, the mounting hole 2a of the printed board 2 has a diameter which is larger than the sum of the diameter of the

mounting screw 7 and a value which is two times as large as the thickness of the ground terminal 5.

When the mounting screw 7 is tightened, the printed board 2 on which the ground terminal 5 is mounted is fastened to the mounting portion 6a of the chassis 6, as shown in Fig. 4B. At this time, the tip ends of the connection portions 5j of the ground terminal 5 are in contact with an upper face of an annular portion of the chassis 6 around the tapped hole 6b. In other words, the connection portions 5j of the ground terminal 5 are in direct contact with the chassis 6, whereby the ground terminal 5 is connected to the chassis 6 with a small connection resistance and hence good electrical conduction is achieved therebetween. In addition, an upper face of the ground terminal body 5' is in urged contact with a lower face of the head of the mounting screw 7 through the plain washer 9 and the spring washer 8, and accordingly, the ground terminal 5 is electrically connected to the chassis 6 through the mounting screw 7.

Figs. 5-10 show ground terminals according to second through seventh embodiments of this invention. In these embodiments, elements corresponding to those of the ground terminal 5 of the first embodiment shown in Fig. 2 are denoted by corresponding reference numerals, and explanations thereof will be omitted.

The ground terminal 11 of the second embodiment shown in Fig. 5 comprises first through fourth connection portions 11j extending from an annular ground terminal body, having an octagonal outer circumference and an octagonal inner circumference, toward the center of the ground terminal 11. Each of the connection portions 11j has a first and a second widthwise half. The first half of each connection portion 11j is formed at its tip end with a notch

11k. The tip end 11m of the second half of each connection portion 11j enters the notch 11k of the adjacent connection portion 11j. When the connection portions 11j are bent along the inner circumference of the annular ground

5 terminal body upon insertion of a mounting screw to connect a printed board mounted with the ground terminal 11 to a chassis, the tip ends 11m of the connection portions 11j are brought in direct contact with the chassis.

As understood from the foregoing explanation, the
10 ground terminal 11 is characterized in that the connection portions 11j are made as long as possible while preventing interference between adjacent connection portions. Hence, the ground terminal 11 can be made compact in size.

The ground terminal 12 of the third embodiment shown
15 in Fig. 6 includes first through fourth connection portions 11j extending from an annular ground terminal body, having an octagonal outer circumference and an octagonal inner circumference, toward the center of the ground terminal 12. The second and fourth connection portions 12j' have their
20 length which is shorter than the length of the first and third connection portions 12j, so that tip ends of the first and third connection portions 12j may enter between tip ends of the second and fourth connection portions 12j'. When the first through fourth connection portions 11j are
25 bent along the inner circumference of the annular ground terminal body, the tip ends of the first and third connection portions are brought in direct contact with the chassis.

The ground terminal 12 is characterized in that the
30 two connection portions 12j are made as long as possible while preventing interference between the connection portions 12j, 12j'. Thus, the ground terminal 12 can be downsized. More generally, among a plurality of connection

portions, those connection portions other than a pair of opposed connection portions may have their length shorter than the length of the paired connection portions, so that tip ends of the long connection portions may enter between
5 the short connection portions.

The ground terminal 13 of the fourth embodiment shown in Fig. 7 includes first through fourth connection portions 13j extending, toward the center of the ground terminal 13, from an annular ground terminal body having an octagonal
10 outer circumference and an octagonal inner circumference. The tip end of each connection portion 13j is formed into an arcuate shape extending along the circumference of a circle centered at the center of the ground terminal 13 and having a radius of r . When the first through fourth
15 connection portions 13j are bent along the inner circumference of the ground terminal body, the tip end of each of the connection portions 13j is in contact with the chassis. The ground terminal 13 is characterized in that the tip end of each connection portion is formed into an
20 arcuate shape to ensure that each connection portion is in contact with the chassis.

The ground terminal 14 of the fifth embodiment shown in Fig. 8 includes first and second connection portions 14j extending from an annular ground terminal body, having an
25 octagonal outer circumference and a square inner circumference, toward the center of the ground terminal 14. Each connection portions 14j has a wide tip end portion 14k facing that 14k of another connection portion 14j, so as to increase a contact area between the tip end of the
30 connection portion 14j and the chassis.

The ground terminal 15 of the sixth embodiment shown in Fig. 9 includes three connection portions 15j of a triangular shape extending from an annular ground terminal

body, having an octagonal outer circumference and a circular inner circumference, toward the center of the ground terminal 15. An elliptical hole 15a is formed in a proximal portion of each connection portion 15j, so that
5 the connection portion 15j may easily be bent. When the connection portions 15j are bent, their tip ends are in contact with the chassis.

The ground terminal 16 of the seventh embodiment shown in Fig. 10 includes three connection portions 16j of a
10 arrowhead shape extending from an annular ground terminal body, having an octagonal outer circumference and a circular inner circumference, toward the center of the ground terminal 16. The arrowhead-shaped connection portion 16j can easily be bent since it has a narrow width
15 at its proximal portion and an elongated hole is formed along the longitudinal axis of the connection portion 16j. When the connection portions 16j are bent, their tip ends are in contact with the chassis.

The present invention is not limited to the foregoing
20 first through seventh embodiments, and may be modified variously.

For instance, each of the ground terminals of the embodiments comprises a polygonal annular ground terminal body having an octagonal outer circumference and an
25 octagonal, square or circular inner circumference. However, in this invention, the outer and inner circumferences of the ground terminal body are not limited to those. For instance, the ground terminal body may be formed into a hexagonal annular shape or a circular annular shape.